

The pump receiving area includes at least one intake port 20, and may include a second port 22, for receiving fluid from the reservoir external to the pump and pumping the fluid. As shown in the drawings, the pump element 14 is preferably attached to rotor shaft and armature assembly 24 of an electric motor generally shown at 26. A gerotor set type pump element is shown. However, other pump elements or types of pumps such as a piston, spur gear, vane, crescent element, centrifugal, turbined and regenerative type pumping systems may be readily utilized. The motor is preferably a brushless motor includes a rotor shaft 28 with magnets 30 in a carrier 31 around the rotor shaft, and coils 32 wound around stator 34. Magnets 30 are configured for reduced windage either by using a polarized cylinder magnet or by filling between magnet segments for providing a full round.

In a preferred embodiment, the stator 34 and armature 24 are configured in a self centering arrangement whereby the armature centers itself in the stator 34 along an axial direction. By positioning the stator, the armature may be biased toward the bearing 48 if desired, or biased for keeping the armature away from contact with the bearing 48 or toward or away from second bearing 54. Typically, the bearings are situated on either side of the armature as shown, however, as will be readily appreciated, the bearings could also be on either side of the pumping element if desired.

In a preferred embodiment, housing 12 includes motor casing portion 40 and a motor cap portion 42. The casing includes a locator shelf 44 and an annular wall 46. The stator is press fit into the housing and abuts against the locator shelf 44. Alternatively, the stator is secured by being roll pinned in place or by other securing means. A bearing 48 is provided which is prefit into cavity 50 in the housing 12.

Bearing 48 rotatably receives rotor shaft 28 therein. The motor cap includes a second bushing receiving cavity 52 for press fit of a second bearing 54 therein. Bearing 52 rotatably receives the other end of shaft 24.

Cap 42 includes lip 55. Lip 55 radially abuts the stator 34. Stator 34 is press
5 fit into the housing. Outer rim 56 of cap 42 is secured in portion 56 and retained either by press fit, rivet, weld, glue or crimped.

In a preferred embodiment of the present invention, the motor may be easily maintained in an open position without the cap 42 if desired, with an upper portion of the pump housing including an opening 36 therein, which allows the motor to be
10 lubricated and/or cooled with the fluid in the reservoir 18. Because the motor is brushless, sealing of the unit is not critical. Parts may be provided for allowing oil to enter and lubricate and cool the motor. A brush type motor can also be employed in the pump of the present invention.

In the case of a brushless motor, a motor controller 58 is utilized for control of
15 the motor function. The motor controller 58 may be positioned anywhere on the motor housing or within the motor housing to take advantage of cooling from the fluid contained in the reservoir. Alternatively, the controller could be remotely positioned in the engine controller unit or elsewhere in the transmission and electrically connected to the motor.

20 In an alternate embodiment, the intake to chamber porting is taken through the housing in an alternate embodiment, as shown in the dashed lines at 38 of Figure 2. This has the advantage of cooling the motor, since oil is flowing through the opening 36 through the interior of the chamber. The opening may be open or a filter unit can be fit over the motor for filtering of oil or transmission fluid.

In the present invention, the pump may be provided for readily adapting to an existing mounting flange for pump porting typically provided in the reservoir of, for instance, a transmission valve body. The pump motor is preferably brushless, which eliminates any problems with brush contamination in operation, and a mechanical means for driving the pump is not necessary. This allows packaging of the present pump assembly in locations previously not thought appropriate to place an electric pump. The advantages of the pump are that it is compact in size, it can be operated submerged, and has a resulting reduced pump noise. Additionally, the porting and fluid passages typically found in the pumps are eliminated and placed in the mounting surfaces, where real estate is not normally an issue. Additionally, because the pump is submerged in the reservoir, corrosion, external leaks from the pump and necessary concerns with respect to sealing of the device at the mounting location and such are not an issue with the present invention, all contributing to reduced cost of manufacture.

The pump of the present invention also allows on demand operational conditions. Because it is electric, the pump can be turned on, off or modulated, independent of engine speed and to match desirable operating conditions. For example, the pump may be started prior to necessary usage requirements, eliminating ramp-up times and system lag found in start-up conditions of typical mechanical pumps. As an alternate example, the pump can be used when the engine is off to keep the transmission charged, i.e., pressure on the clutches and filling the torque converter.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the present invention can be implemented in a variety of